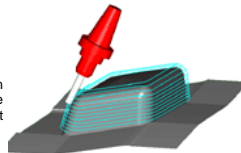


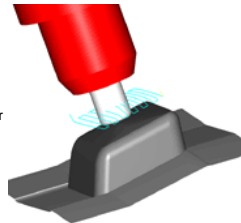
Mould and Die– Industry

Machining of the core

In steep sections of the mould swarf machining on steep surface areas provides great advantages. The contact geometry between cutter and work piece is a line, therefore a lesser roughness can be achieved with less cuts and less time. Small radii and sharp inside corners are marked as remaining stock for subsequent machining. Mould parting surfaces can be defined as check surfaces to be left unmachined by retracting the tool.

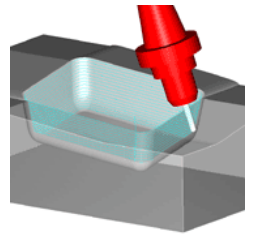


In shallow areas machining time is reduced using a large Bull Nose cutter with a small lag angle. The advantage is again the smaller number of steps to reduce machining time with an improved surface finish.



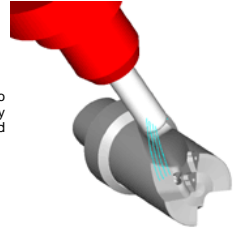
Machining of the Cavity

With deep cavities especially the advantages of **5AxCore** are very evident. The powerful algorithms to automatically tilt the tool and holder away from the work piece in case of collision provide the ability to cut deeper moulds with small radii with standard tools, without surface-finishing spoiling vibrations. Providing this strategy, **5AxCore** enables milling of mould sections, which formerly had been done by Sinker type EDM, thus dramatically shortening the mould making time.



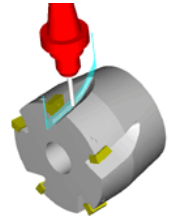
Machining of the cutting Tools

When machining metal cutting tools, it is necessary to mill the flutes in 5-axis simultaneous mode. In many cases it is necessary to machine in several depth cuts as well as from the side, depending on the tool type. Shorter machining time is key because it is a very cost-sensitive business. The reduced machining time required can only be achieved with a very smooth tool path, which is provided only by Direct-to-Bezier- and/or NURBS-Surface Tool path Calculation (DBNSTC) developed by ModuleWorks.



Conical tools

For finishing tool paths on cutting tools the utilization of conical tools is a very good practice. Collision control even on sharp corners between cuts is an essential prerequisite. This is provided by the 5-axis Swarf Motion **Cutter and Holder Collision** (SMCHCC) check module developed by ModuleWorks.



Wood Cutting Milling Cutters

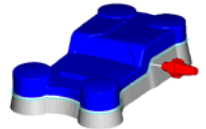
Recently it has been proven that tilting the inserts in the two main axes has lead to a better tool performance of woodcutters.



Plastics Industry

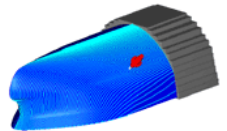
Trimming of Plastic Parts

After production vacuum-formed or fibre-reinforced plastic parts have to be trimmed, drilled, tapped, grooved etc. from all sides. The **MultiXPost** Postprocessor kernel provides maximum control of the spindle direction because with these types of parts both axes are spindle driven and possible collisions need to be avoided. Furthermore automatic collision detection between work piece/fixture versus tool and/or using calculated tool positions is a valuable feature.



Pattern making and Woodcutting

Making patterns, especially pattern of very large parts using 5 Axis machining provides dramatically reduced machining time compared with 3 Axis machining. A large Flat End Mill is oriented perpendicular to the surface thus machining the maximum possible surface area. Another important feature of **5AxCore** allows the user to define a Stock Surface Model for roughing the CAD model to avoid unnecessary air moves.



Trimming of furniture parts

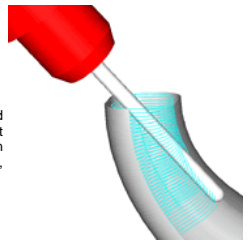
In the Furniture Industry router machines are often used for 5-axis machining. These machines have their rotational axis in the spindle. With these kinds of milling machines, collisions of aggregate and work piece can produce costly damage. ModuleWorks Machine Tool verification **MachSim** as an add-on to the Postprocessor kernel **MultiXPost** we can avoid that and optimize programming time by just trying different set-ups of the part and different starting angles in the verification.



Cylinder Head Machining

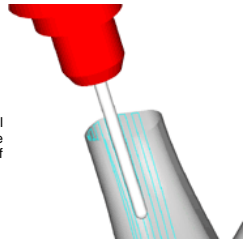
Tool Path Strategies

Development time in the automotive industry continues to decrease with every development cycle. This leads to an increased demand for new, innovative solutions to machine car frames, interior parts, body parts and motors that are even more accurate and cost effective. One of the most complex tasks in building prototype motors is the optimization of porting of the cylinder head, which in turn determine the fuel consumption, power and torque. With its perpendicular to curve strategy **5AxCore** has recently provided a solution, which has led to a breakthrough in dramatically decreasing machining time.



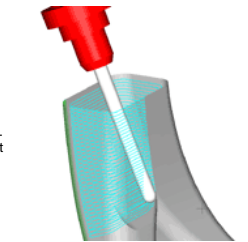
Collision Control

Machining of ports is problematic due to small space for cutter and holder. **5AxCore** with its **CollLib's** Multi-Step collision control provides the necessary options to combine multiple collision avoidance strategies together with the ability to handle undercut tools like Lollipop cutters. At the seat of the valve shaft shank collision control of the sharp corners is also an extremely important feature of **5AxCore**.



Spiral Cutting

Recently the introduction of the Multi-Surface spiral cut option without step over has introduced a new degree of surface quality. Removing surface marks created by the standard step over approaches, "perpendicular to curve" strategy has been an important issue, which with one of the last releases of **5AxCore** has finally been resolved.

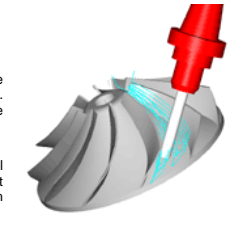


Impeller machining

Roughing of Impellers

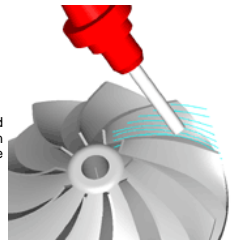
Machining of impellers is one of the most complex tasks of milling. Some of the reasons are that the very small available space for the tool to offset the necessary angular motion of the rotational axis has to be combined with highest requirements of surface quality. Further requirements due to economics, is a reduced machining time with very smooth tool paths on Multisurface-Model. These models, which can have very thin ribs tend to be destroyed by vibrations.

Best results are achieved with depths cuts based on the stock definition of upper and lower surface of the impeller ribs using conical cutters. Another important feature of ModuleWorks range of 5-axis software solutions is the ability of **MultiXPost** to dynamically adjust the feed rate depending on the part setup and the distance between axes. Furthermore **MultiXPost** detects plunge motions, which might break the cutter and automatically outputs a warning so that the tool path can be adjusted with a lag angle in **5AxCore**.



Finishing of Impeller Blades

The critical requirement of finishing the blades of the impeller is accuracy and smooth axis movements, because anything else will end in surface marks and/or surface cut-off. To achieve this kind of tool path **5AxCore** provides a new function to assign tool orientation on 5 Axis Multisurface tool paths to user-defined tool axis vectors. An additional feature to avoid surface marks is the ability of the **MultiXPost** to detect and warn of motions with local reverse of tool path direction vector.

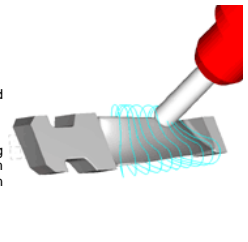


Machining of Turbine Blades

Roughing of Turbine Blades

Turbine blades have always been a classical task for 5 axis machining. It combines the easy and collision free handling and programming of tilted tool plane roughing tool paths using large end mills, with complex 5-Axis simultaneous **5AxCore** tool paths.

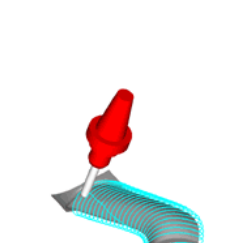
Programming the roughing tool paths, **MultiXPost's** ability to handle tool planes turns out to be essential for a reduced programming time. The post is optimized to support controller cycles for easy tool path handling. Tool path changes can be realized in a minimum amount of time on the machine tool. The machine tool verification MachSim helps to detect collisions due to small available space in advance and thus saves valuable time otherwise spent on tryouts on the real machine.



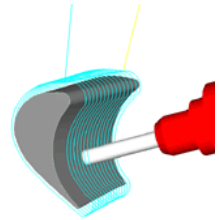
Finishing of Turbine Blades

There are two strategies to finish turbine blades.

The first strategy is to finish with a ball end mill and to tilt the tool to the rotational axis, with a defined angle, to optimize cutting conditions on the blade surface and avoid holder collisions. As a further strategy the spiral tool path is selected to improve surface quality by avoiding marks otherwise left by tool step over.



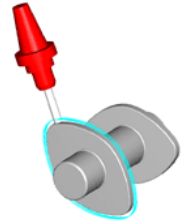
The second strategy is the Multisurface Finishing using the bull nose end mill. Using a large cutter diameter and utilizing **5AxCore's** ability to detect collisions between the cutter and the work piece and to avoid it by tilting the tool, improves machining time compared with strategy #1. A spiral tool path can also be used in this case.



Machining of Excenter valves and Mill Turn machining

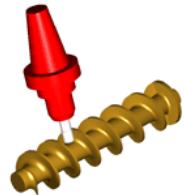
Excenter Shafts

5AxCore offers a variety of functions for machining of Eccentric Shafts. Camshafts and connecting rod journals can be milled with simultaneous 4-Axis with collision check. The stock may be defined and also a cutter shift into cutting direction for rough machining.



Mill Turn

Another application for **5AxCore** is extrusion and injection moulding screws for plastics and rubber processing. It is good practice to use conical tools for this kind of application, which is with all tool paths and collision avoidance strategies supported by **5AxCore**. Multi-Passes for roughing and finishing tool paths may be defined which are closely oriented at the complicated screw shape to avoid unnecessary air moves.



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